FOREST Management BULLETIN

SOUTHEASTERN AREA

EARLY CONSIDERATIONS IN PINE MANAGEMENT

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INTENSIVE MANAGEMENT IS HERE

Neither individuals nor companies today can afford to increase their timber holdings appreciably. To produce additional timber they must increase production on the acreage they now own. Without question the name of the game today is intensive forest management. This includes use of improved stock, matching species to site and products desired, control of spacing and early density, use of improved methods of site preparation, thinning, water control, fertilization, control of competition, and protection against insects, diseases, and wildfires.

As rotations are shortened, intensified management becomes even more important. The returns can be great. For example, Zobel has reported that volume growth from rogued seed orchards is from 10 to 20 percent above commercial planting stock, and predicts an additional 20-25 percent gain in volume from second generation orchards. Fertilization of 10-year and older loblolly pine plantations on Weyerhaeuser Company land in the South has resulted in volume increases from 5 to 60 percent over a three-year period.

When land managers put to use all the practices discussed here in the proper combinations, per-acre yields could possibly double over those considered highly acceptable today.

TREE IMPROVEMENT

The South soon will have enough improved planting stock to regenerate one million acres annually. Gains of 10 to as much as 30 percent in volume yield have been reported where select progenies were planted. In addition, improvements in stem straightness, crown form, and wood density are evident in select materials. Geographic variation, disease resistance, genotype-site reaction, and genotype-cultural reaction have all been demonstrated as capable of making a tremendous impact on management decisions.

Matching species to site. *On certain sandhill sites of the Coastal Plain, Choctawhatchee sand pine has outperformed other pines in height, diameter, and cubic-foot volume. This stand is located on the Chipola Experimental Forest near Marianna, Florida.*

Improved seedlings for most species of southern pine will be available to the small woodland owner within the next 10 years. By planting improved stock, the landowner can expect to manage his woodland on a shorter rotation. He will be able to thin his planted stands earlier for a quicker return on his investment. He will grow higher-quality, more-valuable forest products on his woodland area, and can expect higher returns. With disease-resistant stock, he will be able to grow good timber crops on high-risk areas.

NOTE: This is the second in a series of Bulletins digesting information presented at the "Symposiums on Management of Young Pines," held in Alexandria, Louisiana and Charleston, South Carolina, in 1974. The first Bulletin was devoted to management by objectives. The final one will cover growth, yield, and harvesting. Authors of papers from which this Bulletin was condensed are listed on page 8.

How much site preparation is needed? *Survival, volume, and height often can be increased through intensive site preparation, but cost must be weighed against gain. This particular site was sheared, disked, and burned before planting.*

SPECIES SELECTION

The use of Choctawhatchee sand pine on sandhills of the Coastal Plain is an example of matching species (or variety) to site. A comparison of a 10-year performance of five pines on a variety of sandhill soils in three states indicated the Choctawhatchee variety of sand pine outperformed the others in height, diameter, and cubic foot volume (Table 1).

Table 1.—Performance of selected pines in Florida, Georgia, and South Carolina through plantation age 10 years

Pine	Height (feet)	D.b.h. (inches)	Survival a/ (percent)	Volume (cu.ft./tree)	Volume (cu.ft./acre)
AVERAGE FOR ALL SITES (1103 TREES/ACRE PLANTED)					
Longleaf	14.3	2.9	35	.22	84
Loblolly	13.2	2.4	91	.14	139
Slash	15.2	2.6	89	.19	183
Ocala sand	22.9	3.6	52	.54	309
Choct. sand	23.1	3.8	81	.61	542

a/ Survival at plantation age 5 years. Plantings in South Carolina and Georgia were thinned to relatively uniform densities at age 7 years; those in northwest Florida were not thinned.
Source: Russell M. Burns

MECHANICAL SITE PREPARATION

In deciding upon the intensity of site preparation to employ, one must weigh gains against costs. Some methods, such as fire in sandhill scrub oak, may even be self-defeating.

On dry and infertile sandhill soils, where there is little organic matter, much of the topsoil may be removed and lost by windrowing and piling. Studies in West Florida showed that double chopping with large drum choppers reduced competition without greatly disturbing the soil. The second of two chopping treatments should be applied 6 to 18 weeks after the first.

On the basis of five years' growth, one company found that double disking in the Piedmont and sandhills increased survival by 20 percent and average cubic foot volume by 45 percent over controls. A similar study on the Coastal Plain (data from 4- to 7-year-old pines) indicated that survival, volume, and height increased with the intensity of site treatment. Clearing with a KG blade followed by bedding was among the best treatments. In north Florida another company found chopping, burning, and bedding desirable on poorly drained flatwoods soil. Bedding has also been found beneficial on other poorly drained sites in the Southeast. Subsoiling proved beneficial on eroded soils in the Piedmont and on loessial and eroded soils in Mississippi.

Disking and bedding should be done far enough in advance to allow the disturbed soil to settle. Early mortality can be as much as 40 to 50 percent on freshly disked sites—10 to 15 percent higher than on grass rough where the soil has settled two to three months prior to planting.

Wet pine-growing soils of the west Gulf Coastal Plain dry out and intermittently develop serious moisture deficits in summer, even though they are saturated for prolonged periods in the winter. Recent studies found that variation in growth on wet soils of the West Gulf Coastal Plain was related to the amount of well-aerated soil in the beds. Bedding is the best treatment on soils with slow internal draining and undulating topography.

Comparison of slash-pine-planted sites showed no appreciable differences between burning and flat disking, but trees on bedded sites grew considerably better. At age eight, each additional inch to free water in January and February had increased bole wood more than one-third. cord per acre. Preliminary data indicate the same relationship for loblolly.

Water control for increased growth. *Drainage controls such as this one in North Carolina have raised productivity and helped make site preparation and logging less difficult.*

Result of fertilization. *These five-year-old loblolly pines were aerially fertilized with triple super phosphate during the second growing season.*

WATER CONTROL

Studies on Leon fine sand and Bladen clay loam indicated drainage to a low water table is not required for loblolly and slash pine. One study combined fertilization and different levels of drainage on a Leon fine sand (Table 2). At age five, root biomass with the 18-inch water table increased 69 percent over a fluctuating water table, and that with the 36-inch water table increased 43 percent. Fertilization did not adequately substitute for drainage. Heights and diameters were greatest at the 18-inch water table.

Table 2.—Height and diameter of fertilized and nonfertilized 5-year-old loblolly pines on three water tables (White and Pritchett 1970)

Fertilized a/	Water table b/ (inches)	Height (feet)	Diameter c/ (inches)
No	Fluctuating	6.5	1.8
Yes	Fluctuating	8.2	1.9
No	18	11.7	3.2
Yes	18	13.9	3.4
No	36	9.7	2.7
Yes	36	10.6	2.8

a/ Fertilized at beginning of second year with 350 pounds/acre of diammonium phosphate.
b/ Depth from surface.
c/ Diameter outside bark at ground line.
Source: Carol Wells and Douglas Crutchfield.

PLANTING AND SEEDING TECHNIQUES

Rather than rogue their seed orchard following progeny testing, one company segregated seed by clonal groups based on three-year growth rates. They used three seed classes: A = 30-35 percent height increase over checks; B = 20-27 percent height increase; and C = 7-17 percent height increase. The seed classes were treated as separate seed lots in the nursery and outplanted during the 1970-71 season. After three growing seasons, the three classes exhibited greater height superiority over seedlings from an open market seed source than the progeny testing had indicated. Apparently the segregated planting reduced the intense competition that these seedlings had experienced in the orchard from superior trees (similar to situation of interplanted pines, which grow very poorly). See Table 3. Although it is too early to make a final judgment, it appears that some form of seed separation by growth potential has merit.

Table 3.—Third year heights of indicated seedling classes growing on bedded Leon soils in Taylor County, Florida — slash pine.

Seedling class	Mean 2/ height (feet)	Height in excess of check (percent)	Coefficient of variation (percent)
A	12.68	90	14.5
B	11.09	66	19.3
C	9.38	40	23.6
Check 1/	6.69	—	29.0

1/ Commercial seed lot from south Georgia.
2/ All mean comparisons are highly significantly different.
Source: Walter L. Beers, Jr. and Emmett Johstono

The use of containerized seedlings is a new development that offers an alternative for traditional regeneration systems. Several container systems have the potential to extend the planting season, increase seedling growth, and adapt to automation. Because of the higher seedling costs, they must exhibit superior growth and survival. Large-scale container operations are not recommended before gaining knowledge and experience. It's better to start small before investing heavily in time and capital.

FERTILIZATION

Just a few years ago it was questionable if fertilization of loblolly and slash pine was profitable. Today, on certain soils, the only questions are what fertilizer to apply and under what conditions.

Slash Pines

Two major soil areas, "wet savannas" and "flatwoods," in the Atlantic and Gulf Coastal area have fertilizer response potential for slash pine.

Phosphorous is the element most frequently deficient, particularly in young stands. Numerous field experiments show that, on wet savannas soils, once the need for phosphorous has been met an additional growth response can be expected by adding nitrogen. Adding nitrogen alone consistently results in no response. On these soils fertilization with P or P + N at time of planting is recommended. (Table 4).

Table 4.—Comparative yields at age 13 for P and NP application on Rutledge sand at time of planting — slash pine

Treatments (lbs/acre)	Volume (cords)	Increase (cords)	Increase (percent)
Check	5.63	–	–
50 N 1/	5.20	–	–
35 P 2/	14.08	8.45	150
35 P + 50 N 1/	19.50	13.87	246

1/ 50 pounds of nitrogen as ammonium nitrate applied each of first two years.
2/ From ordinary superphosphate (0-18-0).
Source: Walter L. Beers, Jr. and Emmett Johstono.

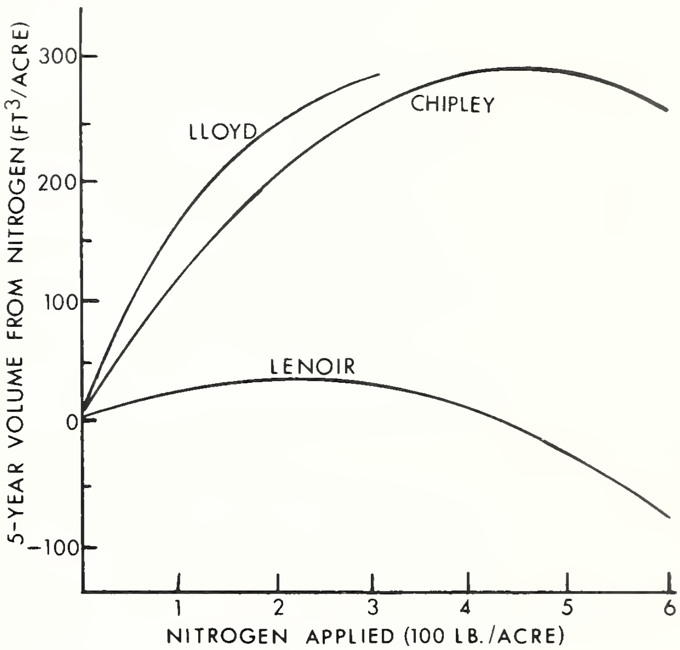
Flatwoods soils are not always deficient in phosphorous, but most respond to phosphorous and phosphorous plus nitrogen at time of planting. Nitrogen alone usually results in increased growth when applied to established stands.

For acid soil with extremely low or extremely high phosphorous-fixing capacity, partially acidulated and pelletized ground rock phosphate (GRP) is best. For soils such as Rutlege and Plummer, concentrated superphosphate (CSP) is advantageous because the high concentration reduces transportation and application costs and high solubility produces quick results.

Loblolly Pine

In the Coastal Plain, greatest gains for loblolly have been from phosphorous applied at planting time and from nitrogen applied to pole-sized stands in both the Coastal Plain and the Piedmont. Early results from studies by industry and forest fertilization cooperatives indicate that plantations from 1 to 36 years of age will respond to nitrogen or nitrogen plus phosphorous. Studies on 19- and 20-year-old loblolly plantations on two Coastal Plain soils (Chipley and Lenoir) and a Piedmont soil (Lloyd) support this conclusion. The Chipley and Lloyd soils were low in nitrogen while the Lenoir was high. The total volume production on unfertilized Lenoir was nearly as high as that of the other two soils with fertilization.

Five-year volume from nitrogen application to plantations of pole-sized loblolly pine on three soils.



Source: Carol Wells and Douglas Crutchfield

Precommercial thinning. ***Intensive management calls for precommercial thinning of natural or direct-seeded stands which have too many stems per acre for maximum growth.***

Table 5.—Eight-Year Data Summary

Initial P Treatments		PO			P25			P50		
Subsequent N Treatments	Year	NO	N69	N71	NO	N69	N71	NO	N69	N71
Avg. Tot. Heights, Ft.	1967	1.1	1.1	1.1	1.8	1.7	1.6	1.7	1.6	1.8
	1974	17.7	16.5	16.6	27.9	26.5	27.2	29.0	27.8	29.6
Avg. DBH, Inches	1971	.92	.81	.90	2.59	2.64	2.84	2.70	2.38	2.96
	1974	3.36	3.24	3.11	5.35	5.44	5.36	5.61	5.59	5.73
Avg. Cu. Ft. Vol./Tree	1971	.025	.021	.021	.240	.239	.282	.264	.253	.337
	1974	.473	.421	.366	1.731	1.725	1.718	1.926	1.916	2.101
Survival %	1971	96	97	96	96	94	97	94	91	94

Source: Douglas M. Crutchfield

On a study in South Carolina, a positive response resulted from P applied at time of planting, but a depressing effect was found when N was applied three and five years later on plots that received no P or 25 pounds/acre of P. There was a positive response from the addition of N on the plots that had received 50 pounds/acre of P (Table 5).

On the phosphorous- and nitrogen-deficient sandhill sites, a preplanting application of 120 pounds of P per acre and two annual applications of 60 pounds of N per acre increased the volume production of Choctawhatchee sand pine by 44 percent over unfertilized trees by age seven.

Some Rules of Thumb:

Soils should always be analyzed to determine the deficiencies before fertilizing.

Slash pine—On wet savannas, fertilize with P or P + N at time of planting with 40 to 100 pounds per acre of P. Trees with abnormally short needles and thin crowns usually respond to P or P + N. On flatwoods N alone usually results in increased growth on established stands.

Loblolly—When P is less than 8 pounds of P/acre (N.C. soil test) or seedlings up to three years of age have less than 0.10 percent foliar P, increased growth should result from fertilizing with P or P + N. Evaluate each site carefully. Consider if anticipated growth will pay for cost of treatment.

PRECOMMERCIAL THINNING

Precommercial thinning is required in badly overstocked stands resulting from natural or direct seeding. There is no precise density to define overstocking for slash or loblolly pines, but suggestions range from 1,500 to 5,000 stems per acre. Residual densities of 500 to 750 trees per acre are recommended.

Thinning by hand is too expensive. Best results are obtained using drum choppers or mechanical brush cutters in stands three to six years old, leaving very narrow strips of trees. Early precommercial thinning has produced dramatic increases in volume growth. At Cordele, Georgia, slash pine thinned at age three produced 16.8 cords per acre at age 17, versus only 1.5 cords for the untreated check. Loblolly intensively thinned at age seven near Crossett, Arkansas, produced 42 cords per acre at age 27, versus 19 cords for the untreated check. Precommercial thinning also rejuvenates wildlife food and cover at a time in the development of the stand when they are rapidly deteriorating. In addition, due to increased diameter growth rates in the released trees, the first prescribed burn can be made earlier than otherwise.

The production of wood on short rotations with total-tree chipping may in some instances offer an attractive option to precommercial thinning. Maximum yield will occur shortly after competition initiates self-thinning. The age and rate at which the maximum is approached depends on initial density; but magnitude of the yield and its quality will depend on age of the trees, site quality, and species. As rotation ages are lowered, greater attention must be given to obtaining the proper density at time of stand establishment to produce the desired tree size and yield at harvest.

Table 6.—Merchantable cubic foot growth and yield of loblolly pine by young stand treatments

Young stand treatment	Merchantable yields (cubic feet per acre) at age:			Growth: Mean Annual Investment
	10	15	20	
Hardwoods not controlled	10	290	848	42
Large hardwoods controlled	70	782	1776	88
Pine precommercially thinned	120	1198	2554	128

Source: O. Gordon Langdon and Kenneth B. Trousdell

Table 7.—Board foot yields of loblolly pine at age 20 under three pine density controls with and without hardwood eradication

Pine density	Yields at age 20: Hardwoods not controlled	Yields at age 20: All hardwoods controlled	Yield increase a/	Percent increase a/
Sq. Ft/acre	Board feet			
60	2989	6078	3089	103
80	1311	5720	4409	336
100	1596	4374	2778	174
Mean	1965	5391	3426	174

a/ Increase attributable to hardwoods.
Source: O. Gordon Langdon and Kenneth B. Trousdell

STAND IMPROVEMENT

On studies with naturally regenerated loblolly in Virginia and North Carolina, controlling large hardwoods at time of regeneration doubled yields. The same treatment combined with precommercial thinning at age 6 tripled yields at age 20. The precommercial thinning treatment (which included cutting small hardwood stems) showed a 44 percent yield increase over the hardwood control only (Table 6).

A second study (Table 7) combined three pine densities with and without removal of small hardwoods. Even with the lowest density, board-foot increase at age 20 was more than 100 percent due to hardwood control. Greatest increase was achieved with the medium density stand.

INSECT DAMAGE

Although a wide variety of insects attack pines, only four groups are really serious: reproduction weevils; tipmoths; sawflies; and bark beetles (southern pine beetle, pine engraver beetles, and the black turpentine beetle).

The reproduction weevils are attracted by the odor of fresh pine resin to areas where pine is being cut. Eggs are deposited in the large roots of fresh pine stumps, where the larvae develop in the inner

Brown spot needle blight. *Prescribed burning is the only economical control of brown spot infection in longleaf. Seedings resistant to the disease soon will be available in limited numbers.*

bark of the root. On emerging, the new adults feed on the tender bark of pine twigs or seedlings, frequently girdling them. Damage can be reduced by a nine-month delay in replanting pines on a cutover area or by dipping the pine seedling roots, prior to outplanting, in a clay slurry which includes Furadan.

Tipmoth attacks rarely have a significant effect on growth, and usually cease after trees attain heights of approximately 10-15 feet. Growth reduction is most serious on poor sites. Areas site-prepared mechanically have been found to have from 1.5 to 4 times the average number of infested tips when compared to chemically prepared areas.

Generally the most serious damage by the sawfly is done by those with multiple generations which feed in the summer and fall on both old and new needles. The trees attacked may suffer a reduction in diameter growth, but usually recover within a year or two. Severe infestations in young plantations will stunt or malform trees, and repeated stripping will sometimes kill them.

The southern pine bark beetles are capable of rapid population buildup that may result in widespread timber losses if conditions are favorable for their development. The most common factor associated with outbreaks is poor tree vigor caused by drouth, fire, lightning strikes, flooding, or careless logging. Thus, the best way to avoid timber losses by bark beetles is to maintain vigorous growth of the stand and avoid damaging trees while logging. Control methods include rapid salvage and utilization, or piling and burning infested material.

DISEASE DAMAGE

Among the most effective defenses against disease are proper site selection, species selection, and the maintenance of healthy, vigorous stands.

Damage from root rot caused by the fungus, ***Fomes annosus,*** is related to site. Soils with 12 inches or more of sand in the top horizon are considered high hazard sites. Old-field sites are also high risk areas. Heavy losses on high hazard sites can be avoided by planting more resistant species such as longleaf pine rather than the more susceptible loblolly or slash. On high hazard sites, close spacings will favor rapid spread of the disease after the first thinning. Delay this thinning as long as possible and make it in the summer, when few fungus spores are present and stump temperatures during the day are usually hot enough to prevent spore germination.

Cornartium fusiforme is a serious disease of loblolly and slash pine. Nursery stock infected with fusiform rust rarely survives for more than three years, hence the need for careful culling at the nursery. Close spacing induces early natural pruning, thus preventing branch galls from reaching the stem. Trees infected with this fungus are unlikely to survive until the next harvest and should be removed during intermediate cutting. Planting rust resistant strains of pine such as loblolly from Livingston Parish, Louisiana, is one approach to the problem. Meanwhile, trees are being screened for resistance for inclusion in seed orchard programs.

Littleleaf disease of pine, particularly of shortleaf pine, is caused by a complex of factors involving the soil fungus ***Phytophthora cinnamomi,*** and adverse soil factors such as poor aeration, low fertility, and periodic moisture stress. Severe littleleaf sites have thin topsoil (the result of past sheet erosion) which is underlain by heavy, plastic, poorly drained subsoil. Littleleaf does not spread from tree to tree, but develops where site conditions favor its growth. Loblolly and other more resistant pines should be favored over shortleaf on littleleaf sites.

Longleaf pine, which is quite resistant to fusiform rust and to southern pine beetle attack, is highly susceptible to brown spot needle blight. Fortunately, strains of longleaf that are highly resistant to brown spot have been identified, and are being grown in at least seven seed orchards across the South. Until resistant seedlings are available, judicious use of fire in naturally seeded longleaf pine stands will help to control brown spot and to start early height growth.

PRESCRIBED FIRE

This valuable management tool is used on about two million acres annually in the South. The primary uses in young stands are rough reduction, disease control, wildlife habitat improvement, and understory manipulation.

The methods used to prescribe burn young stands vary in several respects from those used for older stands. For the first burn, extra care is needed. Fire lines should be plowed no more than ten chains apart, and only a backing fire should be considered. Air temperature should be 40° F. or lower and the relative humidity forecast for the burning day should be no lower than 40 percent. Wind speed should be approximately 10 mph (open station reading) and constant in direction.

The best time to attempt a burn of this type is following the passage of a wet cold front, after the

top layer of the duff has dried sufficiently to support combustion. Wait until after midafternoon, when relative humidity begins to rise.

Initial fuel buildup may require a second backfire the following year. Once the initial fuel is reduced, annual headfires can be used successfully in stands averaging 25 feet in height and 3½ inches dbh.

Block management is another promising method of protecting large contiguous areas of young stands. By interspersing age classes, a checkerboard effect of burned and unburned areas can be developed. Like so many other forestry practices, burning should be done only by experienced personnel.

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